

We claim:

1. A system for monitoring leukocyte migration comprising:
a device including a housing defining a plurality of chambers therein, each of the plurality of chambers including:
a first well region including at least one first well;
a second well region including at least one second well; and
a channel region including at least one channel connecting the first well region and the second well region with one another;
a first fluid stream having a first concentration of a first substance; and
a second fluid stream having a second concentration of a second substance,
wherein the first and second concentrations are different from one another and the first and second fluid streams are in fluid communication with at least one of the plurality of chambers.
2. The system of claim 1, wherein the first and second substance are the same.
3. The system of claim 1, wherein the first and second substance are different.
4. The system of claim 1, wherein the first fluid stream and the second fluid stream converge into a single third fluid stream that is in fluid communication with the at least one of the plurality of chambers, wherein the third fluid stream comprises a concentration gradient of the first and second substances, the concentration gradient being substantially perpendicular to the direction of flow of the third fluid stream.
5. The system of claim 1, wherein the first and second fluid streams converge into a single third stream, then diverge into three separate fourth, fifth, and sixth streams, and then re-converge into a single seventh stream, the seventh stream in

fluid communication with the at least one of the plurality of chambers under conditions of substantially laminar flow.

6. The system of claim 1, wherein the at least one channel comprises a plurality of leukocyte migration mediators or endothelial cells disposed therein.

7. The system of claim 1, wherein at least one of the first and second substance is a cytokine.

8. The system of claim 7, wherein the cytokine is TNF- α .

9. The system of claim 1, wherein at least one of the first and second substance is a test agent.

10. A method of monitoring leukocyte migration comprising:
disposing endothelial cells on a surface;
passing a fluid along the surface under conditions of substantially laminar flow wherein the fluid comprises a concentration gradient of at least one substance, the concentration gradient being substantially perpendicular to the direction of flow;
exposing a sample comprising leukocytes to the surface; and
observing the interaction between the leukocytes and the endothelial cells.

11. The method of claim 10, wherein the at least one substance is a test agent.

12. The method of claim 10, wherein the at least one substance is a cytokine.

13. The method of claim 10, wherein exposing the sample comprising leukocytes to the surface comprises introducing the leukocytes to the surface in a pulsatile manner.

14. The method of claim 10, further comprising providing physiological shear flow along the surface.

15. The method of claim 10, further comprising determining a rolling velocity of leukocytes.

16. The method of claim 1, wherein passing the fluid along the surface under conditions of substantially laminar flow comprises passing the fluid along the surface through a microfluidic network of capillaries.

17. A method of monitoring leukocyte migration comprising:
providing a device including a housing defining a plurality of chambers therein, each of the plurality of chambers including:
a first well region including at least one first well;
a second well region including at least one second well; and
a channel region including at least one channel connecting the first well region and the second well region with one another;
disposing at least one leukocyte migration mediator, or endothelial cells in the at least one channel;
delivering a sample comprising leukocytes to the at least one channel by laminar flow; and
observing the interaction between the leukocytes and the at least one leukocyte migration mediator or the interaction between the leukocytes and the endothelial cells.

18. The method of claim 17, further comprising providing a video camera operatively linked to the device for viewing the at least one channel.

19. The method of claim 18, wherein the video camera is adapted to capture an image during predetermined intervals over a predetermined period of time.